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MAJOR CURRENTS ALONG THE COASTS OF NORWAY AND THE USSR TO THE KURILS

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This Technical Report was prepared by

WILLIAM E. BOISVERT

Oceanographic Analysis Division

Marine Sciences Department

FOREWORD

This is the third of a series of three reports dealing with the identification and description of the major currents of the world. The previous two reports describe the currents of the eastern Pacific and North and South Atlantic Oceans.

The currents treated in this report are those in higher latitudes for which, without exception, available information is insufficient. The principal characteristics of the currents as given herein are based on a variety of sources, including published reports, directly measured data, and unpublished summaries.

F. L. SLATTERY
Captain, U. S. Navy
Commander
Naval Oceanographic Office

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CONTENTS

Page

Foreword i
List of Figures iv
List of Tables iv
Introduction 1
North Atlantic Ocean 2
    Norway Coastal Current
    Norway Current
    North Cape Current
Barents Sea 5
    Murman Coastal Current
    Murman Current
    Kanin Current
    Pechora Current
Kara Sea 8
    Yamal Current
    Novaya Zemlya Current
    Litke Current
    Ob'-Yenisey outflow
Laptev Sea 11
    Severnaya Zemlya coastal flow
    Lena River outflow
East Siberian Sea 13
    East Siberia Coastal Current
Bering Sea 15
    Bering Current
    Anadyr Current
North Pacific Ocean 19
    Oyashio (Kamchatka)
Conclusions 21
References 22

LIST OF FIGURES

Figure Page

1 Major currents along the coasts of Norway and USSR . . . vi
2 Norway Coastal Current profile 2
3 Norway Current profile 3
4 Subsurface current speeds in Bering Strait 16

LIST OF TABLES

Table Page

1 Seasonal distribution of surface drift observations, 69-72°N., 30-39°E. 6
2 Results of current measurements at various locations in the Barents Sea 7
3 Current measurements in the East Siberia Coastal Current 14
4 Observed current at 70.0°N., 178.3°E., 17 and 18 August 1966. 14
5 Observed current at surface and near bottom in August . 16
6 Persistency of the Oyashio south of 56°N., east of 147°E. 20

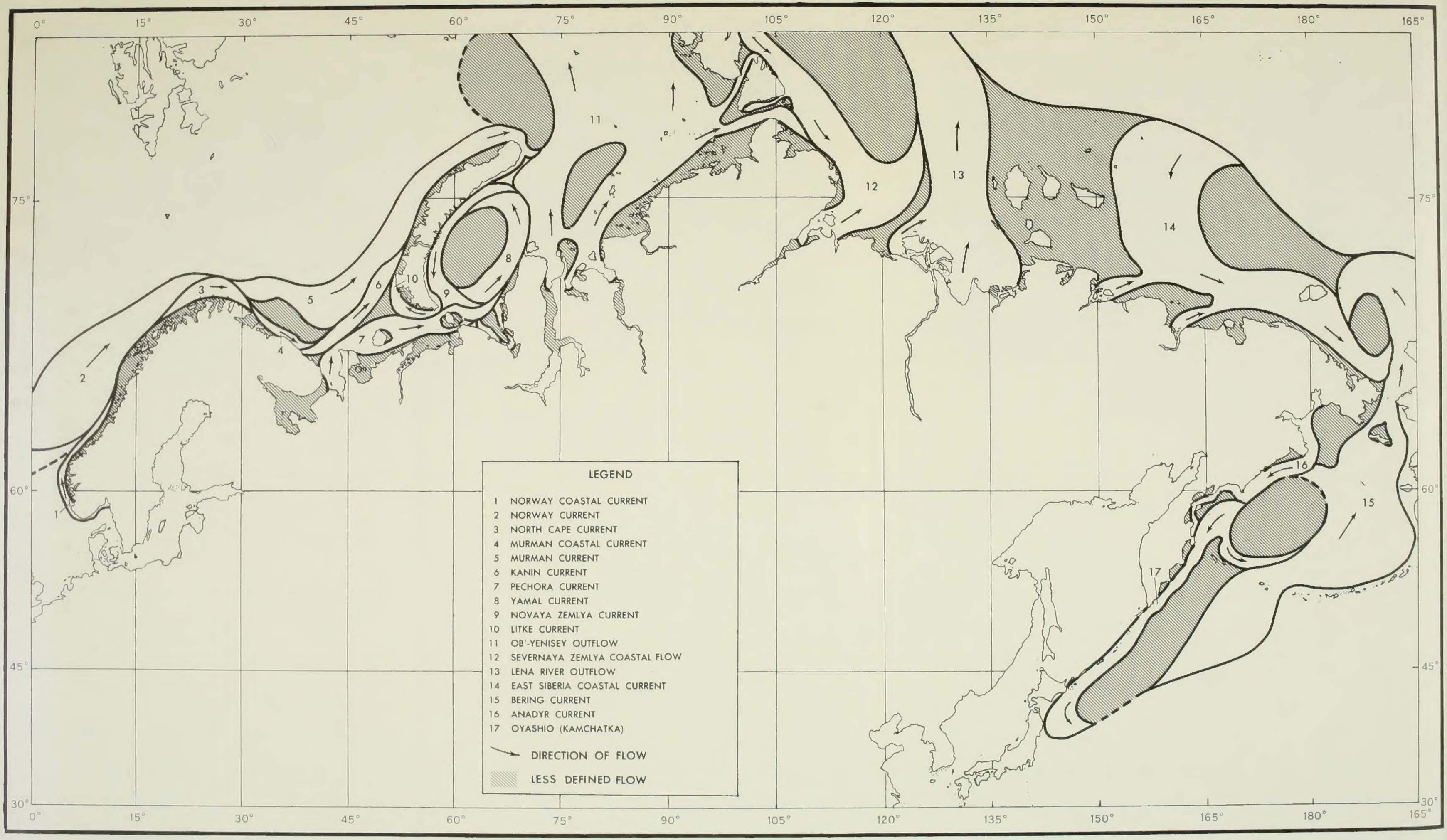

FIGURE 1 MAJOR CURRENTS ALONG THE COASTS OF NORWAY AND USSR

MAJOR CURRENTS ALONG THE COASTS OF NORWAY AND THE USSR TO THE KURILS

Introduction

The usual graphic representation of currents is, at best, a static picture. The water masses, of course, are in constant motion, the movement being exceedingly variable in some regions and relatively constant in others. The currents described in this report are those where the movement within specified boundaries as shown in Figure 1 exhibits a recognizable permanent or seasonal flow. The regions beyond the boundaries of the currents are those where flows, frequently considered part of the prevailing current, are less defined, described from insufficient data, mainly tidal, under the influence of winds or river discharge, or variable and turning. The boundaries are actually regions of gradual change between zones of more persistent flow and zones of less stable or weaker flow.

The approximate boundaries and the main body of each current shown are based on all available information including ship drift observations, direct measurements by instruments, and published and unpublished reports.

Norway Coastal Current

The Norway Coastal Current begins at about 59°N., 10°E. and follows the coast of Norway, as shown in Figure 1. It originates mainly from Oslofjord outflow, counterclockwise return flow of the Jutland Current within the Skaggerak, and outflow from the Kattegat. The current extends to about 20 miles in width. Speeds are strongest off the southeast coast of Norway, where they frequently range between 1 and 2 knots. Along the remainder of the coast the current gradually weakens and may widen to almost 30 miles at about 63°N., where it joins the Norway Current; south of 62°N. the current speed usually ranges between 0.4 and 0.9 knot. Speeds are generally stronger in spring and summer, when the flow is augmented by increased discharge from the fiords.

Although few data are available, the July current profile in Figure 2 shows the usual range of speed and maximum speed observed on the surface and below.

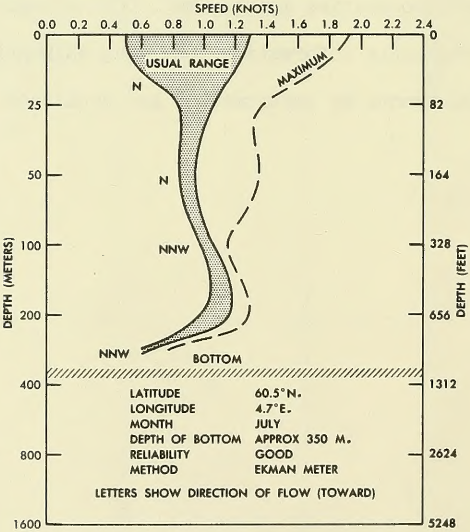

FIGURE 2 NORWAY COASTAL CURRENT PROFILE

Norway Current

The Norway Current is formed mainly from the northeast extremity of the North Atlantic Current that flows past the Faeroe Islands, and part of the southeast flow along the northeast coast of Iceland. The Norway Current is somewhat stronger and more persistent than the North Atlantic Current; frequency of flow ranges between 40 and 75 percent of the time, and speeds usually range between 0.4 and 1.2 knots. Mean speed in the prevailing northeastward direction is 0.6 knot.

Little is known of subsurface flow; computed data indicate that speeds throughout the central region of the current do not diminish significantly in the first 100 meters, and that little movement occurs below 150 meters. It is not considered likely that significent seasonal variations occur in the deeper parts of the current; the most significant or strongest deep currents probably occur over the northern and southern parts of the Norway continental slope, which are narrowest. The profile in Figure 3 shows a fairly stable flow in the southern part of the current.

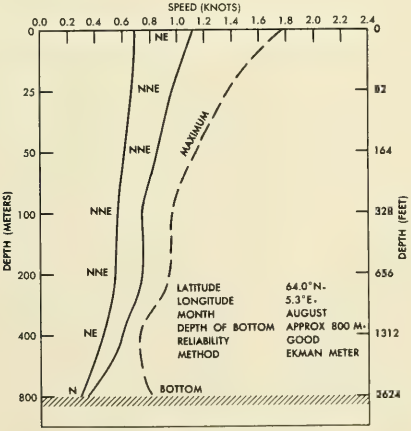

FIGURE 3 NORWAY CURRENT PROFILE

North Cape Current

The North Cape Current is an eastward setting extension of the Norway Current that follows the coast of North Cape throughout the year. Surface drift data available for the region 70°-72°N., 20°-30°E. show that the flow is constant, with a frequency between 50 and 75 percent. Speeds usually range between 0.5 and 1.1 knots, but speeds to 1.5 knots have been observed; mean speed is 0.7 knot. North of 72°N. the flow tends to be variable.

Murman Coastal Current, Murman Current, Kanin Current, Pechora Current

Except for the strait region between North Cape and Bear Island, where depths exceed 400 meters, the shallow Barents Sea has an average depth of about 200 meters, and volume transport into the sea is mainly restricted to the surface layer of Atlantic water at depths which do not exceed those of the Barents Sea. The greatest amount of water transfer occurs between North Cape and Bear Island; maximum flow has been computed at 144,000 cubic meters per second during summer and the minimum flow at 124,000 cubic meters per second during winter.

As with the Kara and Laptev Seas, very little information is available on currents in the Barents Sea, but they are complex and changeable. Winds influence the surface currents by slowing or accelerating them, and altering the directions of flow. The currents also change year to year, with fluctuations in volume transport, seasonal fresh river water discharge, amount of sea ice, and reversing or rotary tidal currents whose maximum speeds in different regions have been observed to vary from 1.1 to 2.3 knots for distances up to 60 miles from the Murman Coast.

As shown in Figure 1, the North Cape Current divides into two branches at about 30°E. The south branch follows the coast to the entrance of the White Sea and is known as the Murman Coastal Current; it does not usually exceed 20 miles in width, and speeds may reach 1 knot. The weaker north branch, called the Murman Current, averages only about 0.3 knot and continues eastward to about 34°E., where it turns east-southeast. At about 38°E. the current widens southeastward then turns northeast, increases in speed to about 1 knot in the vicinity of 71°N., 41°E., and flows toward the northern tip of Novaya

Zemlya at diminished speeds of about 0.5 knot or less. At about 45°E. it meets with the Kanin Current, a northeast-setting extension of the Murman Coastal Current.

During years of maximum intrusion of Atlantic water, the axis of the Murman Current may move northward from 1/2° to 1° of latitutde.

Table 1 shows the seasonal distribution of surface drift observations by directions and mean speed for the area through which most of the Murman Coastal Current and a great part of the Murman Current flow. The constancy of flow is indicated by the percent frequency showing a prevailing east-southeast set of over 55 percent during winter and over 75 percent during summer. It is quite probable that these percentages are higher, since the observations are compiled by 1° quadrangles and the area within which they are located overlaps the boundaries in Figure 1 to include a few observations not considered representative of the currents.

Table 1 Seasonal distribution of surface drift observations, 69°-72°N., 30°-39°E.

Oct. - Mar.					Apr. - Sept.		
Knots			‰	Mean Spd	Knots 0.1-0.8	%	Mean Spd.
Dir.	0.1-0.8	0.9-1.0					
NE 1	12	1	9	0.4	8	6	0.3
E 2	42	5	32	0.5	66	46	0.3
SE 3	37	-	25	0.4	45	31	0.3
S 4	18	-	12	0.4	10	7	0.3
SW 5	8	-	6	0.4	3	2	0.2
W 6	9	-	6	0.4	5	3	0.4
NW 7	4	-	3	0.3	2	1	0.2
N 8	10	-	7	0.4	6	4	0.4

Near the entrance to the White Sea the Murman Coastal Current veers northeastward and is known as the Kanin Current, which flows toward the west coast of Novaya Zemlya. The outflow from the White Sea turns eastward and flows through the Pechora Sea as the Pechora Current.

Table 2 shows results of current measurements at various locations in the Barents Sea.

Table 2 Results of current measurements at various locations in the Barents Sea

CURRENT OBSERVATIONS

Position	Depth (m.)	Dir.	kn.	Depth (m.)	Dir.	kn.	Depth (m.)	Dir.	kn.	Depth of Bottom (m.)
74.5°N. 38.7°E.	0-5	S	0.3	50	S	0.2	150	SW	0.3	185
72.5°N. 33.8°E.	0-5	S	0.3	50	S	0.2	275	SE	0.2	300
72.4°N. 43.7°E.	0-5	ESE	0.1	50	NE	0.1	100	ENE	0.3	392
69.8°N. 41.5°E.	0-5	E	0.2	50	E	0.2	100	E	0.5	120
70.0°N. 50.0°E.	0-5	SE	0.2	35	ESE	0.2	100	SE	0.2	100
68.5°N. 47.0°E.	0-5	SE	0.5	25	NE	0.4	50	SE	0.3	60
70.2°N. 56.3°E.	0-5	E	0.3	50	E	0.3	100	E	0.4	100
72.9°N. 48.3°E.	0-5	NNE	0.6	50	N	0.3	175	NE	0.5	250(est.)

Kara Sea

Yamal Current, Novaya Zemlya Current, Litke Current, Ob'-Yenisey outflow

As shown in Figure 1 there are two separate flow patterns in the Kara Sea, namely a counterclockwise circulation in the southwestern part and a constant river outflow in the northeastern part. There is an inflow of water from the Barents Sea through the two straits between Novaya Zemlya and the mainland, namely Proliv Karskiye Vorota and Proliv Yugorskiy Shar; there is some inflow from part of the Murman Current rounding the northern extremity of Novaya Zemlya and discharge from mainland rivers, chiefly the Ob' and Yenisey.

A large mass of water, the volume varying annually or seasonally, is carried into the Kara Sea by part of the Pechora Current setting east through Proliv Karskiye Vorota. The flow usually extends across more than half the width of the strait from the south shore, and the speed of this constant current usually ranges between 0.5 and 1.0 knot; at times the east-northeastward flow may cross the entire strait and increase to 2 knots with southwesterly winds. Direct short-period observations at 70°10'N., 56°20'E. in the west approach to the strait show a constant flow eastward from surface to bottom at a mean speed of 0.4 knot. Upon leaving the strait, the main part of this current joins the southern part of the Novaya Zemlya Current, and the resultant flow continues northward along the Yamal coast as the slow-moving Yamal Current, with speeds of about 0.2 knot.

As in the Barents and Laptev Seas, the surface flows are considerably influenced by the strength and direction of the wind.

In the southwestern part of the Kara Sea between 70° and 72°N. a wind as high as Beaufort force 4 will cause a current speed of 0.3 knot, force 6 about 0.5 knot, and force 9 about 0.8 knot; these figures are approximate.

The Yamal Current merges with the western part of the Ob' River outflow, continues westward, and forms the south-setting Novaya Zemlya Current that completes the counterclockwise circulation pattern in the southwest Kara Sea. The speed of the Novaya Zemlya Current is about 0.5 knot, and the current ranges in width between 15 and 35 nautical miles, narrower than the Yamal Current. In the vicinity of Proliv Karskiye Vorota a small part of the Novaya Zemlya Current branches off, enters the strait, and sets along the south coast of the island into the Barents Sea; this flow is known as the Litke Current and may not be perceptible during periods when there is a maximum eastward flow through the strait.

The flow in the northeastern part of the Kara Sea is formed mainly by the outflow of the Ob' and Yenisey Rivers as shown in Figure 1.* The speed of the Ob'-Yenisey outflow is estimated at about 0.4 knot in the western part and about 0.2 knot in the eastern part. The flow branches eastward and sets through Proliv Vil'kitskogo at a mean speed of 0.6 knot and is reported more stable along the south shore; since tidal currents occur in the strait, the combination of constant set with westerly winds during the east-setting flood current may result in a speed of several knots at times. There is also an eastward flow through Proliv Shokal'skogo at a mean speed of 0.4 knot.

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* These are the fifth and sixth largest rivers in the world, which together discharge an average of 1,055,000 cubic feet per second, two-thirds again as much as the third-ranked Mississippi River.

Tidal influences in this shallow sea also contribute to variations in speed and direction of currents. In open offshore regions of the Kara Sea their speeds may range between 0.1 and 0.5 knot; during summer in regions free of ice close to the coast, around islands, and in straits current speeds may be high and in some places reach or exceed 3.5 knots. During winter the amount of ice cover will also affect currents; for example, in Proliv Vil'kitskogo between Severnaya Zemlya and the mainland the maximum speed of about 1.5 knots was observed to depths of 50 and 75 meters.

Prevailing northeasterly winds during summer tend to force the Ob'-Yenisey outflow toward Novaya Zemlya; during this period the Novaya Zemlya Current is stronger and the Yamal Current weaker. Southwesterly and southerly winds during autumn, when the rate of river outflow begins to diminish, cause the Yamal Current to widen and shift northeastward, with the result that a lesser amount of water reaches the northeast coast of Novaya Zemlya; during this period the Novaya Zemlya Current is weakened, the eastward flow through Proliv Karskiye Vorota is at a maximum, and the Yamal Current is strengthened.

Laptev Sea

Severnaya Zemlya coastal flow, Lena River outflow

The currents in the Laptev Sea, as with those in the Barents and Kara Seas, are practically unknown. There are no well-known or named currents, and the flows are identified geographically as shown in Figure 1.

Approximately 1.9 X 10^{13} cubic feet of river water flow into the Laptev Sea during the summer and occupy the southern and eastern parts of the sea.

Along the east coasts of Severnaya Zemlya there is a slow movement of arctic water southeastward into the western part of the sea (80°N.,101°E.); speeds are low, averaging about 0.2 knot. The current merges with the flows from Shokalski and Boris Vilkitski Straits and continues at the same speed toward 75°N., 120°E., where it turns eastward at diminishing speed and joins the stronger north-setting Lena River outflow.

In the eastern part of the sea the main flow sets north along 130°E. and is mainly the result of fresh water discharging from the Lena River, the seventh largest river in the world, at the average rate of 547,000 cubic feet per second. Maximum river discharge occurs from ice melt in the spring, and highest speeds in the Lena outflow occur during the second half of July and in August; average speed is about 0.5 knot, and speeds seldom exceed 1 knot.

In the region east of 135°E. the currents are easily affected by winds, and tidal currents and change direction frequently; the results of limited investigations in this region do not show any constant direction of flow. Rapid changes in wind have caused east- or west-setting currents up to 0.8 knot, with speed depending upon strength of the wind. The effect of tidal currents in this shallow region also adds to the complexities of flow.

East Siberia Coastal Current

The East Siberian Sea is a very shallow basin with a level bottom. The currents are constant and should not differ significantly in direction from surface to bottom; however, tidal currents that generally occur in shallow regions may add to the complexity of flow. As in most arctic regions, there is a scarcity of data, and information concerning the origin of the East Siberia Coastal Current is vague or contradictory.

The southeast-setting East Siberia Coastal Current appears to be part of a counterclockwise flow and originates principally from a west-southwest-setting branch of the northwest flow north of 76°N. The region west of 153°E. and south of 78°N. is easily affected by winds and tidal currents, and there is no constant flow; east of this region, eastward sets up to 0.8 knot may occur during westerly winds. The East Siberia Coastal Current follows the trend of the coast, averages about 0.3 knot, and occasionally reaches about 1.0 knot.

The data in Table 3 appear to verify the general surface flow in the East Siberian Sea and neighboring Arctic Ocean. In addition, data on subsurface currents are given.

The current is most persistent and least affected by winds in the region east of 180°. However, the direction of the current can change under the influence of easterly winds as shown by Table 4.

Table 3 Current measurements in the East Siberia Coastal Current

Position	Mo.	Depth (m.)	Dir.	Spd. (kn.)	Depth (m.)	Dir.	Spd. (kn.)	Depth (m.)	Dir.	Spd. (kn.)	Depth to bottom (m.)
69.9°N. 177.5°E.	Jul	0-5	E	0.3	10	E	0.2	25	NW	0.2	30
76.9°N. 166.7°E.	May	0-5	SW	0.3	200	SE	0.3	500	SE	0.2	570
75.3°N. 164.5°E.	Jun	0-5	SSW	0.2	40	SSW	0.2	50	S	0.1	58
78.5°N. 176.5°E.	Apr	0-5	NW	0.3	25	NW	0.3	75	NW	0.2	1800
76.9°N. 166.7°E.	Sep	0-5	W	0.2	65	W	0.2	550	E	0.3	570

Table 4 Observed current at 70.0°N., 178.3°E., 17 and 18 August 1966

Day	DEPTHS (meters)					
	0 - 10		11 - 25		26 - 44 (bottom)	
	DIR.	Mean Speed (kn.)	DIR.	Mean Speed (kn.)	DIR.	Mean Speed (kn.)
17	NNW	0.5	NW	0.4	NW	0.3
18	NNW	0.8	NW	0.6	NW	0.5

The current set in the same direction at each depth on the 17th and 18th, but speeds changed with the wind. Light southwesterly winds on the 17th picked up rapidly to strong southeasterly breezes of 26 knots on the 18th. Current speeds are stronger from surface to bottom, as generally expected, but increase at all depths under the influence of wind; the range of speed during the period of observation was 0.2 to 1.0 knot.

Bering Sea

Bering Current

Sparse available data indicate a general north-flowing current through the eastern half of Bering Sea, through Bering Strait, and in eastern Chukchi Sea. The current originates mainly from the North Pacific Current, and its speed in the Bering Sea is estimated to be usually 0.5 knot or less but at times as high as 1.0 knot.

In Bering Strait current speeds frequently reach 2.0 knots; however, in the eastern half of the strait currents are even stronger and usually range between 1.0 and 2.5 knots. The volume transport of the prevailing northward flow in the strait during August was computed to be about 4.2×10^{12} cubic feet per day. Strong southerly winds may increase current speeds in the strait to 3 knots, and up to 4 knots in the eastern part; persistent strong northerly winds during autumn may cause the current to reverse for short periods. During winter a southward flow at times may occur in the western part of the strait.

After flowing through Bering Strait, the current widens, and part continues toward Point Barrow, where it turns northwest. Table 5 shows prevailing directions and speeds at the surface and near the bottom observed in August at 22 locations in the eastern part of the shallow Chukchi Sea, where 31 current meter stations were occupied. Along the Alaska coast, current speeds have been observed to range between 0.1 and 1.5 knots and increase to 2.0 or 2.5 knots with southerly winds. In the western part of the Chukchi Sea, currents are considerably weaker and do not usually exceed 0.5 knot.

Figure 4A is a composite of 15 current stations in August in the

Table 5 Observed current at surface and near bottom in August

STA.	DIRECTION SUR	DIRECTION NEAR-BOT	SPEED (kn.) SUR	SPEED (kn.) NEAR-BOT	DEPTH (m.) OBS	DEPTH (m.) BOT
1	N	N	0.6	0.5	48	50
2	NNE	NNE	0.5	0.5	34	37
3	NE	N	0.6	0.3	35	35
4	ENE	NE	0.5	0.4	30	30
5	NNE	NNE	0.3	0.2	30	40
6	NNE	N	0.5	0.4	34	34
7	NW	NW	1.0	0.6	35	39
8	WNW	NW	1.1	0.6	35	35
9	NW	WNW	0.6	0.4	30	32
10	NW	WNW	1.2	0.6	45	48
11	N	N	0.8	0.6	45	50
12	WNW	WNW	0.7	0.5	50	55
13	NNE	NNW	1.0	0.3	42	45
14	N	WNW	0.7	0.3	31	35
15	NE	NNE	1.1	0.3	35	38
16	NE	ENE	0.7	0.1	46	46
17	N	NE	0.8	0.4	42	45
18	--	--	0.4	0.4	30	33
19	NNE	N	0.6	0.4	40	50
20	NE	NNW	0.5	0.5	37	40
21	NE	NE	0.6	0.4	42	45
22	NE	N	1.5	0.7	25	29

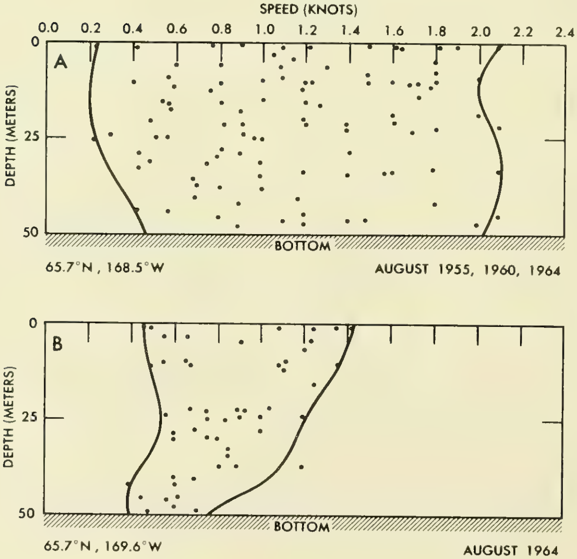

FIGURE 4 SUBSURFACE CURRENT SPEEDS IN BERING STRAIT

eastern part of Bering Strait; the flow ranges between west-northwest and north-northeast and indicates persistent speeds ranging between 0.2 and 2.1 knots. Figure 4B is a composite of 8 current stations in the western part of the strait; the flow there is weaker but still persists between west-northwest and north between 0.4 and 1.4 knots. The current in the Chukchi Sea is augmented by the East Siberia Coastal Current, which joins the north-setting Bering Sea Current north of East Cape.

Northeast of Wrangel Island, in the vicinity of 72°N., 175°W., five current meter stations showed the current to be outside the limit of the northeast flow. The current near the surface appeared to be mainly tidal, changing direction periodically; the tidal effect lessens considerably to a depth of 40 meters and disappears near the bottom.

Anadyr Current

The Anadyr Current originates mainly from rivers discharging into the Gulf of Anadyr, especially from the Anadyr River, which is the largest river flowing into the Bering Sea on the Siberian side. During the spring, when melting occurs, this river may rise 20 feet above its normal level.

The Anadyr Current flows out from the gulf and sets southwest parallel to the coast as far as Cape Olyutorski at 60°N.; along this stretch of coast the current averages about 60 miles in width and has a speed of about 0.5 knot in summer and 0.7 to 1.0 knot in autumn. South of 60°N. the current branches: the main part continues southwestward as the Oyashio; the other part sets around Cape Olyutorski and follows the shore of Olyutorski Gulf, where it attains speeds between 1 and 2 knots, the higher speeds occurring during summer.

Oyashio (Kamchatka)

The Oyashio originates from the main part of the Anadyr Current south of Cape Olyutorski at about 59°N. on the Siberian side of the Bering Sea. It sets westward from this region and has an average width of about 135 miles; the mean speed is about 0.3 knot during summer and 0.5 knot during autumn. In the vicinity of 58°N., 165°E. the current narrows and turns southward along the coast; the current is 30 to 40 miles wide to about 56°N., widens from about 40 to 50 miles as far as 53°N., and averages 0.6 knot. From 53°N. to the southern tip of Kamchatka Peninsula the mean speed increases to about 0.9 knot.

South of 56°N. the Oyashio is very stable throughout the year, and the only variation is in the slightly higher speeds during winter. Table 6 is derived from 502 surface observations and shows the persistency of the Oyashio south of 56°N. and east of 147°E. The total percent frequency in the prevailing south through west quadrant will exceed 60 percent, with maximum speeds reaching 3 knots. Some of the north-, northeast-, and east-setting observations may be partly the result of tidal currents that predominate in the nearshore regions of the Kuril Islands; the remainder of these observations most likely result from the effect of opposing winds upon the weaker flows along the edges of the Oyashio, since the area containing the surface observations slightly overlaps the boundaries of the current.

The Oyashio continues southwestward past the Kurils to a region off the southeast coast of Hokkaido. Here, it is influenced by a branch of the Tsushima Current, which sets from Tsugaru Strait and flows southward close to the coast. The combined Tsushima and Oyashio waters meet the Kuroshio at about 37°N., where mixing and large eddies occur. The exact cause of unusual variable flows in the region south of the Kuroshio is not known, but there is evidence of mixing or upwelling where part of the Oyashio flows under the Kuroshio.

Table 6 Persistency of the Oyashio south of 56°N., east of 147°E.

		KNOTS				TOTAL
	DIR.	0.1-0.8	0.9-1.6	1.7-2.4	2.5-3.0	(%)
PERCENT	NE 1	8.2				8.2
	E 2	8.0				8.0
	SE 3	5.2	0.2			5.4
	S 4	14.0	4.8	1.0	0.8	20.6
	SW 5	19.6	6.2	0.8		26.6
	W 6	14.0	2.8	0.2		17.0
	NW 7	5.4	0.2			5.6
	N 8	6.2	0.4			6.6
	CALM					2.0
	TOTAL					100.0

Conclusions

An examination of existing data sources clearly shows that the methods utilized to determine the principal characteristics of ocean currents leave much to be desired. From the many varied types of information available, it is obvious that detailed, accurate descriptions of currents cannot be readily obtained and that some currents will continue to be better known than others.

It is generally agreed that the ocean current information is very sparse and usually insufficient for most ocean areas, particularly in the higher latitudes where ship traffic is negligible and observations are seldom obtained even by survey vessels. More and better data are required, so that descriptions of currents can be refined to a greater degree of precision.

References

Fleming, Richard H. 1961. Physical and chemical data for the Eastern Chukchi and Northern Bering Sea. University of Washington, Department of Oceanography Tech. Rpt. No. 69, 49p.

Libin, Ia. S. 1946. Hydrological observations. Translated from Ekspeditsiia na samolete "SSSR-N-169" v raion "Poliusa Nedostupnosti". Nauchnye rezul'taty. Moscow. Izd. Glavsevmorputi. pp. 74-123. Translator: David Kraus.

(Hydrological work on the N-169 expedition to the central Polar Basin. Ice drift, ice cover, temperature, salinity, water mass, tidal currents, currents.) 64 p. illus. (AD No. 36346).

Sverdrup, H. U. 1929. The Waters on the North Siberian Shelf. The Norwegian North Polar Expedition with the "Maud," 1918-1925, Scientific Results, Vol. IV, No. 2, Geofysisk Institutt, Bergen, A. S. John Griegs Boktrykkeri, Bergen.

U.S. Naval Oceanographic Office
MAJOR CURRENTS ALONG THE COASTS
OF NORWAY AND THE USSR TO THE KURILS.
June 1970. 26 p. including figures
and tables. (TR-222)

Bibliography: p. 22

This publication identifies and describes the major currents along the coasts of Norway and the USSR to the Kurils.

1. Currents-Coasts of Norway and USSR
2. Coasts of Norway and USSR-Currents
3. North Atlantic Ocean
4. Barents Sea
5. Kara Sea
6. Laptev Sea
7. East Siberian Sea
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3. ABSTRACT

The usual graphic representation of currents is, at best, a static picture. The water masses are in constant motion, the movement being exceedingly variable in some regions and relatively constant in others. The currents described in this report are those which exhibit a recognizable permanent or seasonal flow, are frequently considered part of the prevailing current, are less defined, can be described from insufficient data, are mainly tidal, are under the influence of winds or river discharge, or are variable and turning. The boundaries shown are actually regions of gradual change between zones of more persistent flow and zones of less stable or weaker flow.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Currents Norway USSR Kuril Island Norway Coastal Current Norway Current North Cape Current Murman Coastal Current Murman Current Kanin Current Pechora Current Yamal Current Novaya Zemlya Current Litke Current Ob'-Yenisey outflow Severnaya Zemlya coastal flow Lena River outflow East Siberia Coastal Current Bering Current Anadyr Current Oyashio (Kamchatka)						

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(PAGE 2)